Online Social Support via Avatar Communication Buffers Harmful Effects of Offline Bullying Victimization

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Abstract

Online social support via avatar communication is a powerful tool for bullying victims because they often lack offline social resources. Additionally, avatar communication allows users rich nonverbal interactions (e.g., emotional expressions) while maintaining online anonymity. This study investigates the role of online social support via avatars for victims and how to facilitate such support. Accordingly, we conducted an online questionnaire survey twice on an avatar communication application, Pigg Party, regarding mental health, offline and online social support, and offline bullying victimization (participants: 3,288 (1st wave) and 758 (2nd wave)). We found that online social support via avatars supplemented insufficient offline social resources, particularly when there was a high risk of offline bullying victimization. Furthermore, we investigated how online social support is improved by ego networks using social network data from Pigg Party. We demonstrated that belonging to large and closely connected communities can enhance online social support. Our findings suggest that avatar communication applications can improve players' mental health through online social support, reinforced by facilitating ego networks.

Introduction

Social support can buffer against harmful effects of bullying victimization on mental health (Rothon et al. 2011) (stress-buffering effects (Cohen and Wills 1985)). Social support from the family (Ystgaard 1997; Rothon et al. 2011; Bhui et al. 2017) and offline friends (Ystgaard 1997; Rothon et al. 2011; Kendrick et al. 2012; Rueger et al. 2016; Bhui et al. 2017) improves bullying victims' mental health.

Online social support also improves mental health (Trepte et al. 2015; Cole et al. 2017), particularly for people who lack social resources (Mesch and Talmud 2006; Chung 2013; Yokotani and Takano 2021a; Pierce et al. 2020), including bullying victims (Cole et al. 2017; Takano and Tsunoda 2019). We can expect to complement offline social resources with online social support because online communication has some features that offline communication does not, e.g., anonymity. Notably, communication via avatars can be a powerful tool for online social support because avatar communication allows virtual bodies and facial expressions and gestures in virtual space.

Figure 1: Players chat with them via their avatars in Pigg Party

However, the types of online social support that are effective for offline social support and under which circumstances, are unclear. Herein, we investigated the role of online social support via avatars, focusing on bullying victimization.

- **RQ1**: How does online social support via avatar communication work against bullying victimization?

To investigate the role of online social support, we examined the effects of social environmental changes on social support because In this paper, we consider a behavioral restriction due to COVID-19 as a social environmental change.

Behavioral restrictions due to COVID-19 is a serious problem for bullying victims because the harmful effects of bullying victimization on mental health, which is one of the causes of suicide in school children and adolescents (Matsubayashi et al. 2016), can be mitigated by social support (Rothon et al. 2011; Takano and Tsunoda 2019). On the other hand, such behavioral restrictions mean bullying victims can easily avoid the perpetrators and stressors. For example, the rate of suicide among school children, presumably due to bullying, is low during summer vacations (Carbone et al. 2019; Matsubayashi et al. 2016).

In this study, we investigated the effects of behavioral restriction on the mental health and social support for bullying victims.

- **RQ2**: How does behavioral restriction due to COVID-19 affect bullying victims' mental health and what are the effects of social support on bullying victims?

To answer these questions, we analyzed the results of a

two-wave online questionnaire survey, during behavioral restrictions due to COVID-19 in Japan and after mitigating the behavioral restrictions, on a Japanese avatar communication application, Pigg Party (Fig. 1) regarding social support from family, offline friends, and online friends, as well as mental health, victimization, etc.

The amount of social support depends on social relationships. For example, close relationships provide rich social support (Westmyer and Myers 2006; Kendrick et al. 2012), and many relationships offer opportunities to receive social support. The same is true for online support (Takano and Tsunoda 2019). Herein, we investigated online social relationships facilitating online social support.

- **RQ3**: How do online social relationships facilitate online social support?

To answer this RQ, we analyzed the relationships between online social support and the social network on Pigg Party.

The summary of this paper reveals the following findings: (**RQ1**) Online instrumental support supplements the frequent lack of offline social resources for bullying victims, especially when there is a high risk of offline bullying victimization, (**RQ2**) mitigating behavioral restrictions due to COVID-19 can negatively affect bullying victims because they have to meet their perpetrators, i.e., offline victimization risks are high, and (**RQ3**) belonging to closely connected online communities enhances online instrumental support.

Related Work

Online Social Support

Online social support can complement offline social support (Trepte et al. 2015; Cole et al. 2017). Particularly, this is effective for people who lack social resources (Mesch and Talmud 2006; Chung 2013; Yokotani and Takano 2021a; Pierce et al. 2020), including bullying victims (Cole et al. 2017; Takano and Tsunoda 2019). One reason is anonymity. While not all social platforms have anonymity as the default feature (e.g., Facebook), previous studies showed that those that do promotes self-disclosure of negative experiences (Kang et al. 2016) (e.g., sexual abuse (Andalibi et al. 2016) and bullying victimization (Cole et al. 2017; Takano and Tsunoda 2019)), which are difficult in offline relationships because of the fear of rejection by listeners (Mesch and Talmud 2006; Andalibi et al. 2016).

The effect and role of social support depend on the relationship between recipients and social support sources, and recipients' social environment (Malecki and Demaray 2003; Rueger et al. 2016; Tsuboi et al. 2016; Oriol et al. 2017). For example, a previous study (Malecki and Demaray 2003) reported that students expected empathy and respect from family and friends, informed advice from teachers, and concrete assistance from friends.

Providing empathy, trust, and respect is known as emotional support (Declercq et al. 2007), e.g., encouraging depressed recipients' problems. Such high empathy communication facilitates social relationships (Sharma et al. 2020). Concrete help is known as instrumental support (Declercq

et al. 2007), e.g., providing materials or money and helping recipients' work. Therefore, instrumental support is limited in online spaces. Notably, in text-based online networking services, such as Facebook, instrumental support is not practical (Trepte et al. 2015; McCloskey et al. 2015; Liu et al. 2018). Although there are diverse definitions of the types of social support, these converge on two types of social support, emotional and instrumental support (Shakespeare-Finch and Obst 2011; Obst et al. 2019). These show positive correlations (Semmer et al. 2008; Shakespeare-Finch and Obst 2011; Tsuboi et al. 2016; Obst et al. 2019; Andy et al. 2021) because closeness is associated with both social support. Additionally, instrumental support from friends often includes emotional meaningfulness (Barling et al. 1988; Tardy 1994; Semmer et al. 2008).

Avatar Communication and Online Social Support

Communication via avatars is a powerful tool for online social support. Avatar communication allows virtual bodies, facial expressions, and gestures in virtual space. Individuals can interact nonverbally, which is essential for self-disclosure and social support (Mehrabian 1970; Manusov and Patterson 2006), especially through the Internet (Antonijevic 2008; Green-Hamann et al. 2011), which maintains anonymity (Küster et al. 2015). For example, avatar proxemic behavior in the online virtual world game "Second Life" has provided users with feelings that are typical in the physical world (Antonijevic 2008). In a massively multiplayer online role-playing game, avatars' nonverbal communication drives cooperation between players (O'Connor et al. 2015). Thus, avatar communication promotes social support (Green-Hamann et al. 2011; Takano and Tsunoda 2019; Takano and Taka 2022). However, these qualitative studies have been limited to investigating how and in what settings online social support is provided. Thus, a quantitative investigation is needed to promote online social support via avatars because quantitative evidence enables effectiveness measurements.

Mental Health and COVID-19

Most people have experienced difficulties in receiving social support from offline friends due to the COVID-19 pandemic (Gabbiadini et al. 2020), and their mental health has worsened (Pierce et al. 2020; Lechner et al. 2020). Consequently, the importance of social resources that are not affected by behavioral restrictions due to COVID-19, such as online social support, has increased (Gabbiadini et al. 2020; Saha et al. 2020). As described above, this is also a serious problem for bullying victims.

Materials and Methods

Avatar Communication Application: Pigg Party

Pigg Party is a popular Japanese avatar communication application[1]. In Pigg Party, players communicate using person-

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[1] A previous study reported that there were at least 550,000 active players during half a year (Yokotani and Takano 2021b). The study excluded players who chatted with a specific user more than 100 times a day from their analysis.
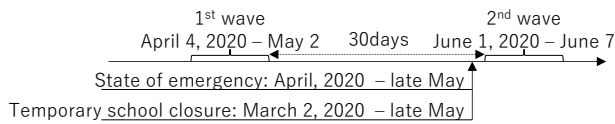
Figure 2: Relationships between the online questionnaire surveys (1st and 2nd waves) and behavioral restriction

alized avatars in virtual spaces (Fig. 1). Pigg Party players are typically females and young people. The female ratio in Pigg Party was 61%, and the teenager ratio in Pigg Party was 65% (Takano and Tsunoda 2019).

Players can synchronously communicate with each other through their avatars in virtual spaces. In addition to sending text messages, players can respond with dozens of avatar animations, known as avatar actions.

Pigg Party offers private room communication spaces to each player. Players can enter a private room by **1)** clicking the *enter* button shown in the profile window of the room owner[2], or **2)** random entry initiated by a random entry mode. In private rooms, players prefer talking with a few friends (Takano and Tsunoda 2019).

Participants

We conducted an online questionnaire survey twice for Pigg Party players (the 1st wave was from April 26 to May 2, 2020; the 2nd wave was from June 1 to 7, 2020). They allowed the authors to analyze their data for academic purposes. The participants of this survey were recruited in Pigg Party. In the 1st wave, the Pigg Party application provider announced the questionnaire survey to all players and sought survey respondents, who would be rewarded with virtual coins amounting to 100 JPY. In the 2nd wave, the provider sent a message to announce the second-wave survey to the first-wave participants, who would be rewarded with virtual coins amounting to 100 JPY. We analyzed players (1st wave: $N = 3,288$; 2nd wave: $N = 758$) who fully answered the questionnaire, and we excluded the most rapid 3% of participants, who completed their questionnaires in less than 4.10 min, as not having answered properly.

The 2nd wave participants were fewer than the 1st wave participants because the Pigg Party application provider announced the questionnaire survey to the first-wave participants; in the 1st wave, the provider announced the survey to all Pigg Party players. That is, their population sizes were different. Additionally, several first-wave participants seemingly refrained from playing Pigg Party.

In Japan, the government declared a state of emergency between April 2020 and late May 2020. All elementary schools, junior high schools, high schools, and special schools were shut down from March 2, 2020, to late May 2020 (temporary school closure). The government strongly discouraged outdoor movement and recommended that restaurants, hotels, movie theaters, etc., be

closed. Consequently, Japanese residents refrained from going out (Mizuno et al. 2021). Therefore, the participants in the 1st wave were strongly restricted in their behavior, and in the 2nd wave, the restrictions were mitigated.

Fig. 2 shows the relationships between two online questionnaire surveys, the state of emergency, and the temporary school closure.

In the 1st wave, 48.8 % were under 18 (the mean age was 24.1; the standard deviation was 13.2); 77.9 % were females,12.4% were males, and 9.7 % were others. In the 2nd wave, 40.5 % were under 18 (the mean age was 25.5; the standard deviation was 12.9); females were 81.4%, males were 11.3%, and others were 7.3%. Herein, the female ratio was higher and the teenager ratio was lower than the actual demographic composition of Pigg Party players, as mentioned above (Takano and Tsunoda 2019).

Most people under the age of 18 seem to be subject to temporary school closures in Japan[3].

Measures

Here, we describe measures based on a questionnaire survey and behavioral logs. See Supplementary information[4] for the questionnaire items used in our survey, their basic statistics, and the results of the factor analyses.

Mental Health We used three measures of mental health: the General Health Questionnaire-12 (GHQ-12) (Goldberg 1972) (Japanese version: (Doi and Minowa 2003)), Quick Inventory of Depressive Symptomatology (QIDS-J) (Rush et al. 2003) (Japanese version: (Fujisawa et al. 2010)), and self-esteem (Rosenberg 1965) (Japanese version: (Uchida and Ueno 2010)). Higher scores on the GHQ-12 and QIDS-J indicated more psychiatric and depressive symptoms, respectively. Higher scores on the self-esteem inventory indicate higher self-esteem. The GHQ-12 and QIDS-J scores were calculated as in previous studies ((Goldberg 1972) and (Rush et al. 2003), respectively). For the self-esteem scale, we conducted confirmatory factor analysis using the maximum likelihood estimation of this scale. Cronbach's $\alpha \in [0, 1]$ for self-esteem was 0.847 in the 1st wave and 0.866 in the 2nd wave. This variable shows the internal consistency of a factor (Cronbach 1951).

There is a difference among these mental health measures in the aspect of timescale. QIDS-J is sensitive for the changes in depressed mood (Rush et al. 2003). Our survey required that participants respond in the last week for this measure, i.e., the timescale of QIDS-J seems to be about a week. GHQ represents a subchronic symptom of mental health (Iwata 1997). Our survey required that participants respond at the last month for this measure, i.e., the timescale of GHQ seems to be about a month. In contrast, self-esteem is more stable than the GHQ (Katreniakova et al. 2010). This measure represents the self-image over the last few years.

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[2]Another player's profile window can be viewed if the player is an *acquaintance* or is in the same room.

[3]In Japan, most people under the age of 18 are considered students because the high school enrollment rate is over 95%. (https://www.mext.go.jp/en/publication/statistics/title01/detail01/1373636.htm#06)

[4]https://doi.org/10.6084/m9.figshare.17111606.v1

Perceived Social Support from Family, Offline Friends, and Online Friends We considered two types of social support and three types of social support sources because these change the buffering effects of social support on mental health (Malecki and Demaray 2003; Semmer et al. 2008; Rothon et al. 2011; McCloskey et al. 2015; Oriol et al. 2017; Trepte et al. 2015; Liu et al. 2018).

We used the social support categorization of emotional and instrumental support (Declercq et al. 2007; Shakespeare-Finch and Obst 2011; Tsuboi et al. 2016; Obst et al. 2019). This categorization is the most overarching, although there are diverse definitions of it (Shakespeare-Finch and Obst 2011; Obst et al. 2019).

In addition to online friends as sources of social support, we considered family and offline friends. These relationships are broadly applicable regardless of context, unlike that between teachers and classmates, which we can use only for surveying students. We used these types because Pigg Party players can have various backgrounds.

In summary, we measured perceived social support (Fukuoka and Hashimoto 1997) from three types of relationships (family, offline friends, and friends in Pigg Party (online)). This scale includes two factors: emotional and instrumental support.

We conducted confirmatory factor analysis using the maximum likelihood estimation of the perceived social support scale. Cronbach's α for emotional and instrumental support from family was 0.923 and 0.900, respectively, from offline friends was 0.930 and 0.902, respectively, and from online friends was 0.947 and 0.964, respectively, in the 1st wave. Cronbach's α for emotional and instrumental support from family was 0.941 and 0.918, respectively, from offline friends was 0.942 and 0.918, respectively, from online friends was 0.952 and 0.966, respectively, in the 2nd wave.

We used the results of principal component analysis (PCA) for perceived emotional and instrumental support for each source type, according to the concept of principal component regression (Jolliffe 1982). This is because emotional and instrumental support frequently show a high correlation (Semmer et al. 2008; Shakespeare-Finch and Obst 2011; Tsuboi et al. 2016; Obst et al. 2019), which leads to multicollinearity in regression analyses of mental health (Tsuboi et al. 2016). The correlations between the two types of social support were 0.904 for family, 0.830 for offline friends, and 0.510 for online friends.

The PCA results revealed the same two principal components for social support from family, offline friends, and online friends. The first principal component was the strength of perceived social support that integrated the two types of social support (ISS). On all social support sources, the coefficient of this component is 0.707. The second principal component is the relative strength of perceived emotional support compared to perceived instrumental support (REI). On all social support sources, the coefficient of this component is -0.707. The value of the REI is positive when perceived emotional support is stronger than perceived instrumental support and vice versa. We can compare the effects of ISS and REI between source types in the following analysis because the coefficients of each principal component were the same for the sources of social support.

We describe ISS and REI for family, offline friends, and online friends as ISS-F, ISS-Off, and ISS-On and REI-F, REI-Off, and REI-On, respectively.

Offline Victimization We used a Japanese bully/victim questionnaire (Yokotani and Takano 2021a), which is based on the Revised Olweus Bully/Victim Questionnaire (Olweus 1996), to evaluate offline victimization. We conducted the confirmatory factor analysis by maximum likelihood estimation of this scale. Cronbach's α values for offline victimization were 0.895 (1st wave) and 0.910 (2nd wave).

We regarded the interaction between bullying victimization and explanatory variables relating to social support as a stress-buffering effect for victimization. For interpretability, we transformed this measure into a binary dummy variable that is 1 (participant is a victim) when this measure is larger than its mean (zero) and 0 otherwise (participant is not a victim). The ratios of victims in the first and 2nd waves are 19.9% and 16.0%, respectively.

Number of Avatar Actions We counted the avatar actions of each player. This variable indicates the number of emotional expressions in communication (Takano and Tsunoda 2019). We used the previous four weeks with respect to each wave (for the 1st wave, March 29 to April 25, 2020; for the 2nd wave, May 3 to May 31, 2020). This variable was standardized (mean: 0, standard deviation: 1).

Ego-networks We constructed the features of the participants' ego networks using the logs of their visits to others' private rooms. We used the previous four weeks with respect to each wave (for the 1st wave, March 29 to April 25, 2020; for the 2nd wave, May 3 to May 31, 2020). We assumed an edge between a visitor and a room owner, as in previous work (Yokotani and Takano 2021c), because visitors need permission from the room owner to enter the room. The weights of the edges depend on the dwelling time.

We use the following ego network features (i is the player's index): 1) total contact frequency (activeness; a_i) as a 1st-order feature (Takano 2018), 2) the number of edges (extensiveness of relationships; k_i) and the mean contact frequencies of these edges (mean closeness; m_i) are 2nd-order features of ego networks (Takano 2018), and 3) weighted clustering coefficients (c_i) (Clemente and Grassi 2018) as the 3rd-order feature. Player i's mean closeness m_i is $\frac{1}{k_i}\sum_{j \in C_i} w_{ij}$, where C_i is the set of i's connected nodes and w_{ij} is the edge weight between i and j (contact frequency). The weighted clustering coefficients c_i of i is described as $\frac{WA^2}{s_i(k_i-1)}$, where W is a matrix constructed by w_{ij}, A is the adjacency matrix of nodes, and s_i is $\sum_{j \in C_i} w_{ij}$. These variables were standardized (mean: 0, standard deviation: 1).

Control Variables

Demographic Information The participants provided their demographic information, including sex (female, male, and others) and age (1–120). In the following regression analyses, male is a reference to the sex variable.

Sexual and Gender Minorities We used a dummy variable that expresses whether a participant is a member of a sexual or gender minority (LGBTQIA) because a previous study on the Pigg Party (Yokotani and Takano 2021a) showed that it significantly affected social support. Although the study analyzed specific types of minorities, we used a dummy variable (sexual/gender minority) because this was a control variable. The ratios of minorities in the first and 2nd waves were 39.6% and 39.2%, respectively.

Perceived Difficulty of the Survey We used the time spent on our survey as the perceived difficulty of the survey to control for participation bias. The correlation between the perceived difficulty of the 1st wave survey and the 2nd wave participation was -0.007 (p−value = 0.692). This variable was standardized.

Statistical Model

Social Support Effects To evaluate the association between social support and mental health, we used multiple regressions in which response variables were measures of mental health, and the explanatory variables were victimization, perceived social support, and the interaction between social support and victimization. We used the first-wave survey data for this analysis.

The victimization variable shows victimization affected mental health. The social support variable shows social support affects mental health without the influence of victimization (the main effect (Cohen and Wills 1985)). The interactions between social support and victimization variables showed the stress-buffering effects (Cohen and Wills 1985) of social support against victimization. As a control, we used the above control variables, but we did not analyze them.

Change in Social Support Effects with and without the Behavioral Restriction To evaluate differences in social support effects between the first- and second-wave surveys, we 1) applied the above regression model for social support effects to the 2nd wave survey data and 2) evaluated the differences between the coefficients of the results of the 1st and 2nd regression analyses. The differences between the two indicate changes in social support effects on mental health due to the presence or absence of behavioral restrictions.

Association between Avatar Actions and Online Social Support A multiple regression model was used to investigate the association between avatar actions and online social support. The response variables were emotional and instrumental online support, and the explanatory variable was the number of avatar actions. As a control, we used the above control variables and activeness a but did not analyze them. Activeness controlled players' usage frequencies, which definitely correlate with avatar actions.

Ego-network Effects on Online Social Support To investigate the effects of online ego-network structure on online social support, we used a multiple regression model, where the response variables were emotional and instrumental online support and the explanatory variables were the features of ego networks. As a control, we used the above control variables, but did not analyze them.

Ethics Approval Statement

Our study was approved by the ethics committee of a Japanese university.[5]. All procedures were conducted in accordance with the guidelines for studies involving human participants, ethical standards of the institutional research committee, and 1964 Helsinki Declaration and its later amendments.

The participants in this study provided informed consent to participate in our survey and could stop at any time. They could also withdraw their responses after completing the survey. We informed participants that this questionnaire survey was required to respond to mental health and bullying victimization. This informed consent form showed an inquiry contact form for the request for disclosure and withdrawal of their responses.

The Pigg Party application provider collects log data and questionnaire survey data based on terms of service[6], privacy policy[7], and the informed consent for the survey. The application provider explicitly stated the usage purpose and scope of the data provision of the log and survey data on informed consent. The provider explained that the the data was solely for academic research and that the provider would not use the questionnaire data for their business. The authors who received the data were explicitly declared to the participants on the informed consent form. The provider provided the participants' log data to the authors after removing the identification data based on the informed consent.

Additionally, all Pigg Party players, who were not limited to survey participants, accepted the terms of service and privacy policy, which allowed the analysis of their behavioral data for service improvements and academic studies. The data was pseudonymized and identification data removed.

Quantitative data outputs are presented at aggregate level meaning no identifying information is presented.

Results

Preliminary Analysis

Mental health measures did not significantly change between the first and 2nd waves. The mean differences in GHQ-12, QIDS-J, and self-esteem were -0.537 (p-value: 0.710), 0.209 (p-value: 0.381), and 0.001 (p-value: 0.881), respectively.

Victims' perceived social support from family and offline friends was less than that of the other participants. In contrast, victims' perceived social support from online friends was higher than that of the other participants.

The mean difference of ISS-F between victims and other participants was -0.461 (p-value: 0.000) and -0.651 (p-value: 0.000), respectively. The mean difference of ISS-Off between victims and other participants was -0.263 (p-value: 0.000) and -0.409 (p-value: 0.007), respectively. In contrast, the mean difference of ISS-On between victims and other participants was 0.142 (p-value: 0.009) and 0.087 (p-value: 0.012), respectively.

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[5]We will describe the name of this university after a review.
[6]https://lp.pigg-party.com/terms
[7]https://www.cyberagent.co.jp/way/security/privacy/

Social Support Effects on Mental Health

The first-wave columns in Tables 1, 2, and 3 show the results of the multiple regressions for social support effects on mental health (GHQ-12, QIDS-J, and self-esteem, respectively) using the first-wave survey data. The rows starting with "Victimization" show the interaction between victimization and social support.

Social support was positively associated with better mental health. Social support from family (ISS-F) and offline friends (ISS-Off) was negatively associated with GHQ-12 and QIDS-J and positively associated with self-esteem. Social support from online friends (ISS-On) was negatively associated with GHQ-12. For the other measures, ISS-On did not show significant effects. The absolute values of the effect sizes were ISS-F, ISS-Off, and ISS-On in decreasing order.

The comparisons between emotional and instrumental support showed different tendencies due to source type. Emotional support from family (positive REI-F) was associated with better mental health than instrumental support for all mental health measures. In contrast, instrumental support from offline and online friends (negative REI-Off and REI-On) was associated with better mental health than emotional support. REI-Offs were significant for all mental health measures; REI-On was significant for the GHQ-12.

For victimization, social support from family was more important than for people without victimization (victimization:ISS-F for GHQ-12 and QIDS-J), and emotional support (victimization:REI-F for GHQ-12) was more important than instrumental support.

Change of Social Support Effects with and without a Behavioral Restriction

The second-wave columns in Tables 1, 2, and 3 show the results of the multiple regressions for social support effects on mental health using the second-wave survey data. The difference columns show the change in social support effects due to the mitigation of behavioral restrictions.

Regarding social support effects, REI-Off changed for GHQ-12 and self-esteem. That is, instrumental support effects increased compared with emotional support when behavioral restrictions were mitigated. In other words, people required more emotional support from offline friends during behavioral restrictions than after restrictions were mitigated.

The adverse effects of offline victimization were intensified by mitigating behavioral restrictions (victimization in QIDS-J). That is, victims' mental health became worse.

Meanwhile, the importance of online social support for victims increased (Victimization:ISS-On in GHQ-12).

Association between Avatar Actions and Online Social Support

Table 4 presents the results of multiple regression analyses for online emotional and instrumental support (response variables) through the number of avatar actions and the control variables. It only shows the results of the 1st wave because there was no significant difference between the first and 2nd waves regarding the number of avatar actions. The number of avatar actions was positively associated with both types of social support, particularly emotional support.

Online Ego-networks Reinforcing Online Social Support

Table 5 shows the results of multiple regression analyses for emotional and instrumental online social support (response variables) through the ego-network features and the control variables. This table only shows the results of the 1st wave because there was no significant difference between the first and 2nd waves regarding ego network features.

These two types of social support indicated different associations with the ego-network features. All ego-network features were positively associated with perceived emotional support. In contrast, only two ego-network features, the extensiveness of relationships and the clustering coefficient, were positively associated with perceived instrumental support. That is, belonging to highly connected and large communities enhanced both types of support. In addition, closeness and activeness reinforced emotional support.

Discussion

Role of Online Social Support (RQ1)

Online social support is important for bullying victims, who tend to lack social support from family and offline friends. Online support seems to have a greater effect when there is a high risk of offline bullying victimization, i.e., under intense stress in the physical world. Additionally, such support can work with/without bullying victimization. In this section, we discuss the role of online support and the differences in social support resources.

Social support, regardless of the nature of the relationship and the presence or absence of stressors associated with better mental health, supported the main effects model (Cohen and Wills 1985). Social support from family showed more substantial positive effects on participants' mental health than that of friends, consistent with (Malecki and Demaray 2003; Tsuboi et al. 2016). Social support from offline friends indicates stronger positive effects from online friends, as in (Cole et al. 2017), because face-to-face communication can create stronger ties than online communication (Mesch and Talmud 2006; Takano 2018).

The relation with sources affected the effective types of social support. Perceived emotional support from the family is more effective for mental health than instrumental support from them, as is consistent with (Malecki and Demaray 2003). In contrast, perceived instrumental support from offline and online friends is more effective for mental health than perceived emotional support. However, it is difficult, due to behavioral restrictions, for these friends to meet and help recipients. Additionally, Pigg Party bans players from physically meeting other players, and players aim to maintain a separation between online and offline relationships (Takano and Mizuno 2018).

Instrumental support from friends often includes emotional meaningfulness (Barling et al. 1988; Tardy 1994; Semmer et al. 2008) because paying costs for instrumental support (time, effort, and resources) is a costly signal (Smith

	1st wave				2nd wave				Difference		
	Coef.	S.E.	p-value		Coef.	S.E.	p-value		Δ	p-value	
Intercept	2.059	0.213	0.000	***	2.213	0.534	0.000	***	0.154	0.789	
ISS-F	−0.420	0.057	0.000	***	−0.518	0.115	0.000	***	−0.098	0.446	
ISS-Off	−0.211	0.060	0.000	***	−0.108	0.126	0.389		0.104	0.460	
ISS-On	−0.125	0.059	0.032	*	0.123	0.121	0.308		0.249	0.064	
REI-F	−0.926	0.212	0.000	***	−0.257	0.402	0.522		0.669	0.141	
REI-Off	0.570	0.173	0.001	**	1.343	0.322	0.000	***	0.773	0.035	*
REI-On	0.298	0.098	0.002	**	0.293	0.204	0.151		−0.004	0.984	
Victimization	1.359	0.148	0.000	***	1.912	0.369	0.000	***	0.553	0.165	
Female	0.890	0.174	0.000	***	0.717	0.398	0.072		−0.173	0.691	
Others	0.461	0.259	0.075		−0.448	0.619	0.470		−0.909	0.176	
Sexual/gender minority	0.806	0.130	0.000	***	1.241	0.283	0.000	***	0.435	0.162	
Age	0.031	0.005	0.000	***	0.025	0.011	0.020	*	−0.005	0.652	
Perceived difficulty of the survey	−0.097	0.056	0.085		−0.185	0.123	0.160		−0.089	0.513	
Victimization:ISS-F	−0.224	0.109	0.040	*	0.098	0.308	0.749		0.323	0.323	
Victimization:ISS-Off	0.005	0.118	0.963		−0.002	0.288	0.994		−0.007	0.981	
Victimization:ISS-On	−0.005	0.122	0.970		−0.744	0.322	0.021	*	−0.739	0.032	*
Victimization:REI-F	−1.148	0.451	0.011	*	−1.800	0.985	0.068		−0.649	0.549	
Victimization:REI-Off	0.712	0.384	0.064		−0.389	0.758	0.608		−1.100	0.195	
Victimization:REI-On	−0.113	0.231	0.625		−0.301	0.489	0.539		−0.188	0.728	
R^2	0.161				0.164						

Table 1: Social support effects on GHQ-12. ***, **, and * indicate significant differences at p−values $\leq 0.001, 0.01,$ and 0.05, respectively (the symbols have the same meaning in what follows).

1994) which conveys positive emotions. Therefore, instrumental support from offline or online friends is associated with better mental health.

The positive effect of online instrumental support is inconsistent with previous studies on asynchronous text-based online networking services (Trepte et al. 2015; McCloskey et al. 2015; Liu et al. 2018), in which instrumental support was not practical. The instrumental support effect of online friends in Pigg Party may result from embodiment in virtual worlds reinforcing social support (Collange and Guegan 2020). A previous study on the same platform (Pigg Party) (Takano and Tsunoda 2019) reported that players who were bullying victims in the physical world frequently used synchronous text communication and avatar actions to express their emotions for self-disclosure; listeners of such self-disclosure also used emotional expressions using synchronous text communication and avatar actions. For example, the bullying victims used the words of "distress," "cutting-off," "suicidal feelings," etc., and avatar actions of "wailing" etc., to express their pain. Corresponding to such communication, listeners also use these words to show empathy. Such communication is conducted in closed spaces with a few friends (private rooms). Moreover, in an interview with the company that runs Pigg Party, players said that they use avatar actions to express emotions that cannot be expressed in text (Takano and Mizuno 2018). Our results also demonstrated that avatar action frequency is positively associated with online emotional and instrumental support. This suggests that players used avatar actions to express their

emotions, which may have played an important role in self-disclosure and social support, as shown in previous studies (Green-Hamann et al. 2011; Takano and Tsunoda 2019).

Therefore, online instrumental support via avatars can convey positive emotions (Barling et al. 1988; Tardy 1994; Semmer et al. 2008), similar to with offline friends. Consequently, instrumental support seemed to have positive effects on mental health, even if its availability was low.

Interestingly, online social support was only associated with GHQ-12. In other words, online social support prevented mental health deterioration, although this support did not change self-image over the last few years (self-esteem) and did not rapidly lower depressed mood (QIDS-J). This is because online social support facilitates recipients' positive emotions although it does not affect negative emotions (Oh et al. 2014). Therefore, online social support was not associated with depressed mood (i.e., negative emotions). In addition, online social support does not directly affect life satisfaction (it works only indirectly) (Oh et al. 2014). Hence, this support was not associated with self-esteem, i.e., a way of thinking through life. The positive association between GHQ-12 and online social support suggests that recipients receiving positive emotions via online social support prevented mental health deterioration (Bolier et al. 2013). Online social support may maintain recipients' positive emotions and lower the risk of developing mental illness (Bolier et al. 2013). Avatar communication may have contributed to conveying positive emotion (Takano and Tsunoda 2019).

Social support from family, particularly emotional sup-

	1st wave				2nd wave				Difference		
	Coef.	S.E.	p-value		Coef.	S.E.	p-value		Δ	p-value	
Intercept	4.502	0.348	0.000	***	3.402	0.855	0.000	***	−1.010	0.233	
ISS-F	−0.739	0.093	0.000	***	−0.794	0.184	0.000	***	−0.055	0.790	
ISS-Off	−0.283	0.099	0.004	**	−0.177	0.201	0.378		0.106	0.636	
ISS-On	0.027	0.096	0.777		0.359	0.194	0.064		0.332	0.125	
REI-F	−1.025	0.345	0.003	**	−0.909	0.644	0.158		0.116	0.874	
REI-Off	0.792	0.283	0.005	**	1.678	0.515	0.001	**	0.885	0.132	
REI-On	0.237	0.160	0.139		0.329	0.327	0.315		0.091	0.802	
Victimization	3.086	0.242	0.000	***	4.740	0.592	0.000	***	1.650	0.010	**
Female	1.009	0.284	0.000	***	1.623	0.637	0.011	*	0.624	0.371	
Others	0.646	0.422	0.126		0.527	0.992	0.595		−0.119	0.912	
Sexual/gender minority	1.856	0.213	0.000	***	2.196	0.453	0.000	***	0.341	0.496	
Age	0.033	0.007	0.000	***	0.035	0.017	0.044	*	0.002	0.933	
Perceived difficulty of the survey	−0.069	0.092	0.453		−0.261	0.198	0.188		−0.192	0.378	
Victimization:ISS-F	−0.469	0.178	0.008	**	−0.180	0.493	0.716		0.290	0.581	
Victimization:ISS-Off	−0.045	0.192	0.815		−0.311	0.461	0.501		−0.266	0.595	
Victimization:ISS-On	−0.034	0.200	0.867		−0.534	0.516	0.301		−0.500	0.366	
Victimization:REI-F	−0.840	0.736	0.254		−1.528	1.577	0.333		−0.687	0.693	
Victimization:REI-Off	0.838	0.628	0.182		−0.262	1.215	0.830		−1.100	0.421	
Victimization:REI-On	−0.109	0.376	0.771		−1.053	0.784	0.179		−0.944	0.278	
R^2	0.176				0.216						

Table 2: Social support effects on QIDS-J

port, showed positive effects on the mental health of bullying victims, consistent with (Rothon et al. 2011), supporting the stress-buffering effects model (Cohen and Wills 1985). However, support from offline and online friends did not have significant effects on bullying victims' mental health. This may suggest difficulties complementing social resources from family by offline and online friends.

In contrast, after mitigating behavioral restrictions, online social support for victims became significant for better mental health, supported the stress-buffering effects model (Cohen and Wills 1985). Additionally, victims' perceived social support from online friends was greater than that of other participants, although their perceived social support from family and offline friends was less than that of others. Victims who lack social resources may receive social support in the virtual world. This suggests that online social support can complement victims' insufficient social resources, such as self-disclosing bullying experiences and receiving social support regarding them (Takano and Tsunoda 2019). This effect is more likely to appear if the stressor is strong.

Effects of Behavioral Restriction due to COVID-19 on Mental Health and Social Support (RQ2)

Mitigating behavioral restrictions due to COVID-19 increased the harmful effects of offline bullying victimization on mental health because bullying victims had to meet their perpetrators. This suggests that for bullying victims, behavioral restrictions was preferable, although the behavioral restrictions increased friction in families, and social/economic challenges increased (Humphreys et al. 2020; Wade et al.

2021; Cameron et al. 2020; Racine et al. 2021). This result is similar to the increase in suicides by school children who are bullying victims immediately after long vacations, although their suicide rate is low during long vacations (e.g., in the US (Carbone et al. 2019) and Japan (Matsubayashi et al. 2016)). When bullying victims are exposed to an intense stressor, online social support is essential.

Mitigating such restrictions also changed the offline support effects. The relative importance of instrumental support from offline friends increased. Participants may have expected instrumental support from offline friends (Cohen and Wills 1985; Wethington and Kessler 1986).

Online Social Support and Ego-networks (RQ3)

Online social support can be reinforced by improving online ego-network structures (Pérez-Aldana et al. 2021). Online emotional support was positively associated with all ego-network features. Online instrumental support was positively associated only with the extensiveness of relationships and clustering coefficients. This suggests that the feeling of belonging to a community, i.e., having many friends in common, can improve the perceived instrumental support. These ego-network effects on online social support did not change significantly due to the mitigation of behavioral restrictions.

Social networks composed of elaborate communication methods, e.g., face-to-face communication, have higher cluster coefficients than those consisting of light communication methods, e.g., e-mail and social media (Takano and Nakazato 2021). The elaborate communication methods including avatar communication, may reinforce emotional and

	1st wave				2nd wave				Difference		
	Coef.	S.E.	p-value		Coef.	S.E.	p-value		Δ	p-value	
Intercept	0.240	0.055	0.000	***	0.014	0.135	0.912		−0.225	0.122	
ISS-F	0.154	0.015	0.000	***	0.137	0.029	0.000	***	−0.018	0.592	
ISS-Off	0.095	0.016	0.000	***	0.091	0.032	0.004	**	−0.004	0.906	
ISS-On	−0.009	0.015	0.541		−0.053	0.031	0.082		−0.044	0.197	
REI-F	0.115	0.055	0.035	*	0.109	0.101	0.282		−0.006	0.959	
REI-Off	−0.096	0.045	0.032	*	−0.300	0.081	0.000	***	−0.204	0.028	*
REI-On	−0.006	0.025	0.825		0.061	0.051	0.236		0.067	0.245	
Victimization	−0.230	0.038	0.000	***	−0.236	0.093	0.012	*	−0.007	0.948	
Female	−0.193	0.045	0.000	***	−0.104	0.100	0.302		0.090	0.419	
Others	−0.113	0.067	0.091		0.128	0.156	0.412		0.241	0.156	
Sexual/gender minority	−0.275	0.034	0.000	***	−0.239	0.071	0.001	***	0.036	0.645	
Age	0.003	0.001	0.008	**	0.007	0.003	0.011	*	0.004	0.196	
Perceived difficulty of the survey	0.018	0.014	0.221		0.062	0.031	0.046	*	0.045	0.194	
Victimization:ISS-F	0.027	0.028	0.337		−0.013	0.078	0.862		−0.041	0.624	
Victimization:ISS-Off	−0.027	0.030	0.378		−0.047	0.073	0.516		−0.021	0.794	
Victimization:ISS-On	0.033	0.032	0.301		0.137	0.081	0.092		0.105	0.230	
Victimization:REI-F	0.099	0.116	0.392		0.048	0.248	0.848		−0.052	0.850	
Victimization:REI-Off	−0.178	0.099	0.072		−0.085	0.191	0.658		0.094	0.664	
Victimization:REI-On	−0.026	0.059	0.667		−0.231	0.123	0.062		−0.205	0.134	
R^2	0.174				0.158						

Table 3: Social support effects on self-esteem

instrumental support.

This finding suggests that application providers can improve social support between players to enhance their mental health via intervention in players' social relationships, e.g., by friend recommendations.

Online communication platforms are required to maintain a safe environment to facilitate online social support. Facilitating online social support without adequate prevention of antisocial behavior, e.g., cyberbullying, grooming by sexual predators, and pyramid financing, would endanger people because these behaviors seemingly involve superficial close relationships. Pigg Party is taking actions against such behavior, such as through awareness building, monitoring players' communication, and banning offending players (Ueda 2022). Studies on enhancing these actions is required for facilitating online social support.

Limitations and Future Work

We studied the association between social support and mental health and between ego networks and online social support. An experimental study to improve online social support by manipulating social relationships should be performed to determine the intervention outcomes for ego networks.

There is still room to examine our analyses, e.g., the effects of avatar actions by action type (positive, negative, etc.) and participant bias.

Communication data (e.g., linguistic information and avatar actions) is helpful for exploring how communication provides social support, e.g., (Sharma and De Choudhury 2018; Takano and Tsunoda 2019). Utilizing it is strictly re-

stricted by the constitutionally guaranteed secrecy of communication. If obtaining valid consent for analyzing the data, it can provide significant insights into online social support studies.

We surveyed players on an avatar communication application, Pigg Party. Considering other online communication platforms, e.g., a platform where players' demographic composition will be different and providing different user experiences etc., would broaden the scope of our findings.

Conclusion

In this study, we showed that online social support can help offline bullying victims. Particularly, when the risk of offline bullying increases, e.g., after mitigating behavioral restrictions and after long vacations, online social support becomes essential for victims' mental health. That is, online social support can complement insufficient offline social resources because players can express their emotions via their avatars on the avatar communication application. Such support can be reinforced by facilitating online social relationships.

These findings suggest that the mental care of bullying victims and bullying prevention are more important immediately after mitigating behavioral restrictions and long vacations than during ordinary times. Thus, online avatar communication may be suitable for helping victims.

Promoting online social support is also beneficial for application providers. This can increase user satisfaction and happiness because providing social support improves the mental health of recipients and sources (Morelli et al. 2015;

	Emotional support				Instrumental support			
	Coef.	S.E.	p-value		Coef.	S.E.	p-value	
Intercept	0.319	0.075	0.000	***	0.491	0.074	0.000	***
Avatar actions	0.128	0.021	0.000	***	0.049	0.021	0.022	*
Activeness	0.083	0.020	0.000	***	0.051	0.020	0.009	**
Female	0.023	0.061	0.707		−0.159	0.061	0.009	**
Others	0.132	0.090	0.142		0.172	0.090	0.055	.
Sexual/gender minority	−0.123	0.045	0.006	**	0.047	0.045	0.296	
Age	−0.008	0.001	0.000	***	−0.016	0.001	0.000	***
Perceived difficulty of the survey	0.001	0.019	0.880	**	−0.006	0.019	0.737	
R^2	0.052				0.080			

Table 4: Association between avatar actions and perceived online social support

	Emotional support				Instrumental support			
	Coef.	S.E.	p-value		Coef.	S.E.	p-value	
Intercept	0.151	0.066	0.048	*	0.396	0.065	0.000	***
Activeness	0.059	0.023	0.009	**	0.021	0.022	0.342	
Extensiveness of relationships	0.136	0.022	0.000	***	0.096	0.021	0.000	***
Mean closeness	0.061	0.019	0.002	**	0.010	0.019	0.610	
Clustering coefficient	0.065	0.018	0.000	***	0.036	0.018	0.042	*
Female	0.058	0.055	0.285		−0.101	0.053	0.058	
Others	0.173	0.082	0.034	*	0.230	0.080	0.004	**
Sexual/gender minority	−0.089	0.041	0.030	*	0.040	0.040	0.313	
Age	−0.006	0.001	0.000	***	−0.015	0.001	0.000	***
Perceived difficulty of the survey	−0.000	0.017	0.844	**	0.001	0.017	0.942	
R^2	0.053				0.079			

Table 5: Ego network effects on perceived online social support

Inagaki et al. 2016; Tsuboi et al. 2016). This may produce a comfortable society for users in the virtual world, which also allows application providers to acquire more users.

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